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## Taxonomic study of the genus *Gonepteryx* Leach, 1815 and genus *Dercas* Doubleday, 1847 (Lepidoptera: Pieridae) from India

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### Abstract

In this present research work, the morphological characters, genitalic attributes of *G. mahaguru* Gistel, *G. rhamni* (Linnaeus) and *Dercas lycorias* (Doubleday) including its male form *decipiens* have been studied, illustrated and compared. Dixey (1894)<sup>[4]</sup> discussed the close relationship of *Dercas* Doubleday with *Gonepteryx* Leach on the basis of their phylogeny, wing markings and geographical distribution. Klots (1931) studied and illustrated their genitalic structures.

**Keywords:** *dercas lycorias*, *decipiens*, *gonepteryx rhamni*, *gonepteryx Mahaguru*, male genitalia, female genitalia

### Introduction

The genus *Dercas*, commonly known as the Sulphurs has been erected by Doubleday (1847)<sup>[5]</sup> and is distributed in the areas of Sumatra, Java, Malay Peninsula, Borneo, upper Burma, China and mountains of North-East India. It is a small genus with total number of four species reported globally (Bridges, 1988)<sup>[3]</sup> and out of these, only two species i.e. *Dercas verhuelli* Hoeven and *Dercas lycorias* (Doubleday) are found in India. *Dercas lycorias* (Doubleday) is protected under Schedule II of the Indian Wildlife (Protection) Act, 1972. Whereas, the genus *Gonepteryx* Leach comprises nine species distributed widely in Afrotropical region, Asia and Europe (Sondhi and Roy, 2013)<sup>[8]</sup>. The total number of four species i.e. *G. amintha* Blanchard, *G. chitralensis* (Moore), *G. mahaguru* Gistel and *G. rhamni* (Linnaeus) have been reported from India so far. The members of this genus are univoltine (Krpac and Mihajlova, 1997). The genus *Gonepteryx* Leach has been studied by various eminent workers like Dixey (1894), Bingham (1907), Antram (1924), Klots (1931), Evans (1932) and Talbot (1939)<sup>[4, 2, 1, 7, 6, 9]</sup>. During present studies the male genitalia of scheduled species *Dercas lycorias* has been studied and compared with form *decipiens*. The male and female genitalia of two species of genus *Gonepteryx* i.e. *G. mahaguru* Gistel, *G. rhamni* (Linnaeus) has been studied and compared with closely allied genus *Dercas*.

### Materials and Methods

During present studies the specimens of *Dercas lycorias* (Doubleday), *Gonepteryx rhamni* (Linnaeus) and *Gonepteryx mahaguru* Gistel were studied from the collections lying in the National Museum, Zoological Survey of India, Kolkata. The images of both the sides i.e. dorsal and ventral sides of the specimens were obtained with a digital camera (Nikon D7000 18-105 mm). The genitalia dissections have been done by adopting the method proposed by Robinson (1976). The photography of the male external genitalia has been done by using Leica binocular microscope equipped with a photographic unit.

### Observations and Discussion

**Genus *Dercas* Doubleday, 1847<sup>[5]</sup>**

**Common name: Sulphurs**

*Dercas* Doubleday, 1847; *Gen. diurn. Lep.* (1): 70<sup>[5]</sup>.

*Dercas* Winhard, 2000; *Butterflies of the World* 10: 13.

**Type species: *Colias verhuelli* van der Hoeven, 1839**

*Colias verhuelli* van der Hoeven, 1839; *Tijdschr. Nat. Gesch.* 5 (4): 341.

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**Diagnosis:** Forewing dorsal side gamboges-yellow; orange bordered discocellulars; a sienna-brown patch at the apex with posteriorly narrow and reaches upto vein 1A (Anal vein 1); the inner border of the patch is angular in area M<sub>1</sub> (Median vein 1); orange post-discal thin band arising from the angular part in area M<sub>1</sub> and reaches upto vein 1A. Ventral side dull yellowish and maculation same as on the dorsal side; three minute red spots at the costa; silver coloured scales passing through apical patch. Hindwing dorsal side with costa pale-yellow; marginal vein spots sienna-brown coloured. Ventral side with reddish veins near the cell and reddish post-discal band.

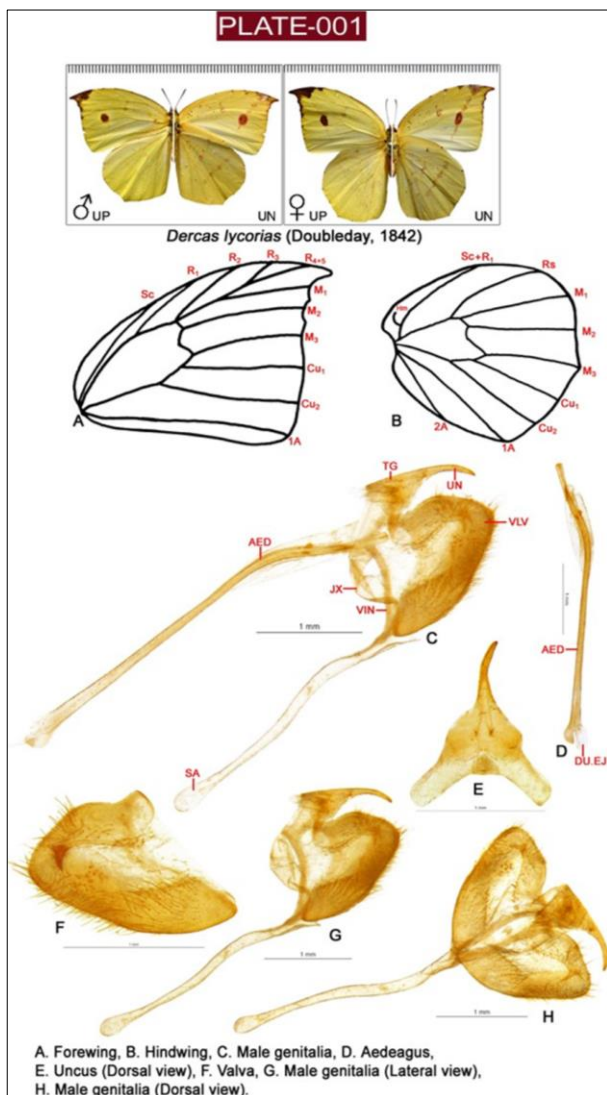
***Dercas lycorias* (Doubleday, 1842)**

**Common name: Plain Sulphur**

*Rhodocera lycorias* Doubleday, 1842; *Zool. Miscell.*: 77.

*Dercas lycorias* Talbot, 1939; *Fauna Brit. Ind. Butts.* 1: 504 [9].

**Adult (Male) (PLATE-001)**



**Plate 1:** Adult (Male)

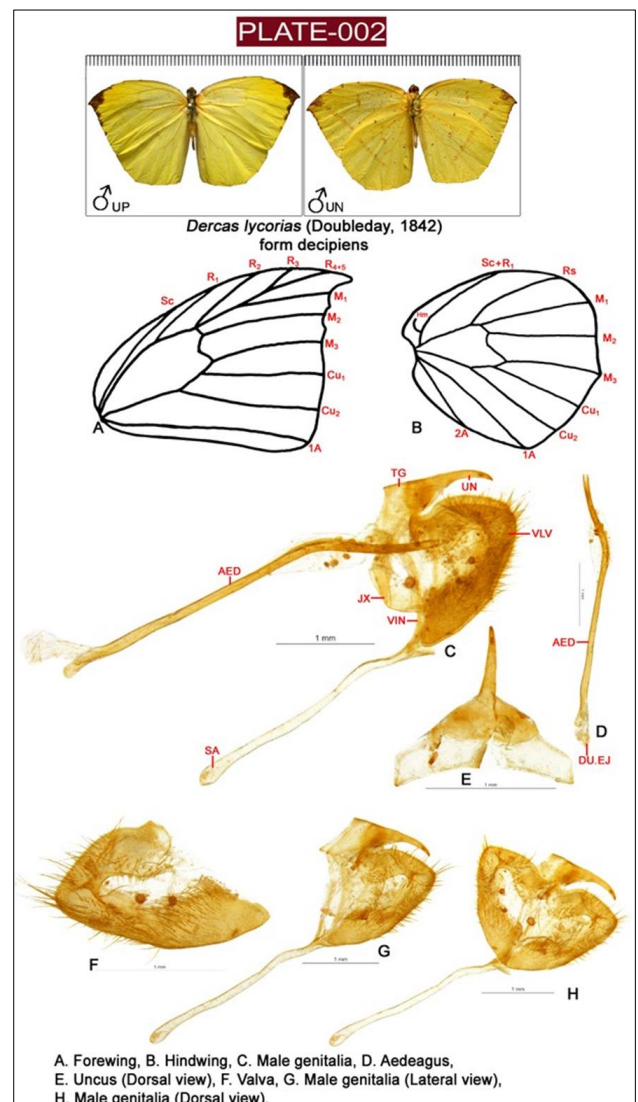
Forewing dorsal surface lemon-yellow or neon-yellow; apex falcate with narrow apical tip, the margin below the apex is incurved and dentate at vein ends of veins M<sub>1</sub>, M<sub>2</sub> (Median vein 2) and M<sub>3</sub> (Median vein 3), dark brownish apical patch;

very small brownish spots on veins M<sub>2</sub> and M<sub>3</sub>; large circular dark blackish-brown spot in the centre of area M<sub>3</sub>. Ventral surface lemon-yellow; dorsum white; cell with scattered minute brownish spots; two silver discocellular spots ringed with reddish brown; a thin bar arising obliquely from the costa passes through the circular brownish spot and reaching upto area Cu<sub>2</sub> (Cubitus vein 2). Hindwing dorsal surface lemon-yellow with whitish costa; vein M<sub>3</sub> dentate; veins with very minute brownish spots. Ventral surface lemon-yellow; cell with minute scattered brownish spots; two silvery discocellular spots ringed with reddish-brown; post-discal light-brownish bar inbetween the costa and tornus; small brownish spots on the veins.

**Male (form decipiens) (PLATE-002)**

All the markings are same as in the principal form. A circular brownish-black spot in area M<sub>3</sub> of forewing is not present in form decipiens and the apex of forewing less produced.

**Wing expanse: 55-60 mm.**



**Plate 2:** Male (Form Decipiens)

**Male Genitalia:** Uncus extremely thin, arched, tip pointed, as long as tegumen; latter somewhat triangular from lateral view; vinculum concave, thin, sclerotized; saccus extremely long, sinuous, distal end blunt; appendices angulares narrow; valve

small, marginal area setosed, broad proximally, distal end narrow and rounded, costa convex, harpe spine-shaped; aedeagus extremely narrow and long, distal part of suprazone curved, broad, ductus ejaculatorius enters dorsally, vesica dorso-apical.

**Material examined:** ZSI, Kolkata, National Zoological Collections.

1♂ (form *decipiens*), 1♀, 25.iii.1961, Jhumla, Kameng; 1♂, 5.v.1961, Shergaon, Kameng.

**Distribution India:** Arunachal Pradesh.

**Elsewhere:** Burma, Yunnan, China.

**Remarks:** *Dercas lycorias* (Doubleday) is protected under Schedule II of the Indian Wildlife (Protection) Act, 1972. Dixey (1894) [4] discussed the close relationship of *Dercas* with *Gonepteryx* on the basis of their phylogeny, wing markings and geographical distribution. Klots (1931) [7] studied and illustrated their genitalic structures. In this present work, the morphological and genitalic attributes of *Dercas lycorias* male and its male form *decipiens* have also been studied and compared. Talbot (1931) described this form and concluded that it is confined to the males. In *Dercas lycorias*, a circular brownish-black spot is present in area M<sub>3</sub> of forewing whereas it is absent in form *decipiens*. The genitalic structures of both are similar. The genitalic attributes of both i.e. *Dercas lycorias* and *Dercas lycorias* form *decipiens* have been studied, illustrated and compared for the first time in this present work.

**Genus *Gonepteryx* Leach, 1815**

*Gonepteryx* Leach, 1815; *Edinburgh Ency.* 9: 127.  
*Gonoptera* Billberg, 1820; *Enum. Ins. Mus. Billb.:* 76.  
*Rhodocera* Boisduval, 1830; *Hist. Lep. Am. Sept.:* 70  
*Goniapteryx* Westwood, 1840; *Introd. Class. Ins.* 2: 87.  
*Goniopteryx* Wallengren, 1853; *Skand. Dagfjar.:* 145.  
*Goniopteryx* Burmeister, 1878; *Descr. Phys. Rep. Arg.* 5:75.  
*Gonopteryx* Schatz, 1886, *Exot. Schmett. Bd* 1: 68.  
*Gonepteryx* Winhard, 2000; *Butterflies of the World* 10: 11.

**Type species: *Papilio rhamni* Linnaeus, 1758**

*Papilio rhamni* Linnaeus, 1758; *Syst. Nat.* (Edn 10) 1: 470.

**Diagnosis:** Forewing costa arched with falcate apex. Hindwing with veins Cu<sub>1</sub> (Cubitus vein1) and Cu<sub>2</sub> protrudes to form a tooth, vein Rs (Radial Sector) swollen. Tegumen small; aedeagus long and slender, valve leaf like with well developed harpe; apophysis posterioris short, weakly developed, signum large, spinose, dumble shaped.

**Distribution:** Africa, Algeria, Asia minor, Canary islands, China, Europe, India, Japan, Korea, Madeira, Morocco, Russia, Siberia, Syria, Taiwan, Tunisia, Yunnan.

**Key to species of the genus *Gonepteryx* Leach**

1. Forewing with less crescent apex. ♂ With both wings sulphur yellow; Uncus short, narrow with blunt apex. ♀ hindwing with large orange colored discocellular dot; signum narrow, appendix bursae somewhat oval.....*rhamni* (Linnaeus)  
 - Apex of forewing strongly produced, crescent shaped; ♂ forewing yellow in colour and hindwings creamy white; Uncus long, narrow, curved with sharp apex. ♀ hindwing

with small orange colored discocellular dot; signum broad, appendix bursae rounded.....*mahaguru* Gistel

***Gonepteryx rhamni* (Linnaeus, 1758)**

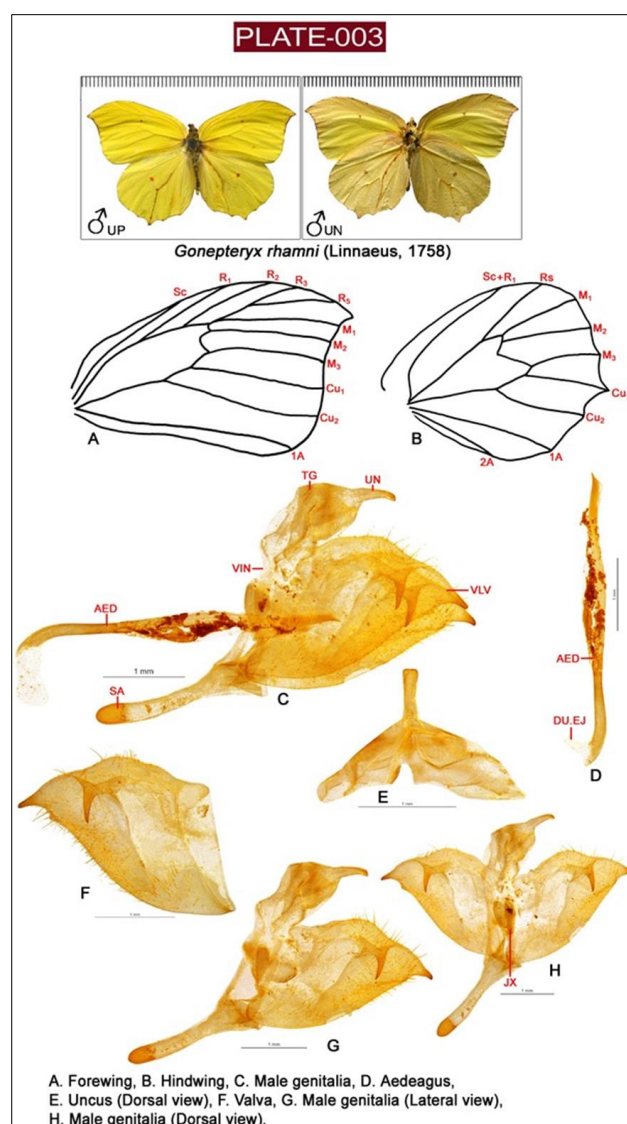
**Common name: Common Brimstone**

*Papilio rhamni* Linnaeus, 1758; *Syst. Nat.* (Edn 10) 1: 470.

*Gonepteryx rhamni* Korb & Bolshakov, 2011; *Eversmannia Suppl.* 2: 24.

**Adult (Male) (PLATE-003)**

Forewing dorsal surface neon-yellow; dark orange small spot at the end cell; brownish-red vein spots on the termen. Ventral surface greenish-yellow; costa and apex ochraceous-yellow; posterior part more greenish-yellow; dark spot at the end cell. Hindwing dorsal surface neon-yellow; discocellular spot much larger. Ventral surface light greenish-yellow; prominent discocellular dot.



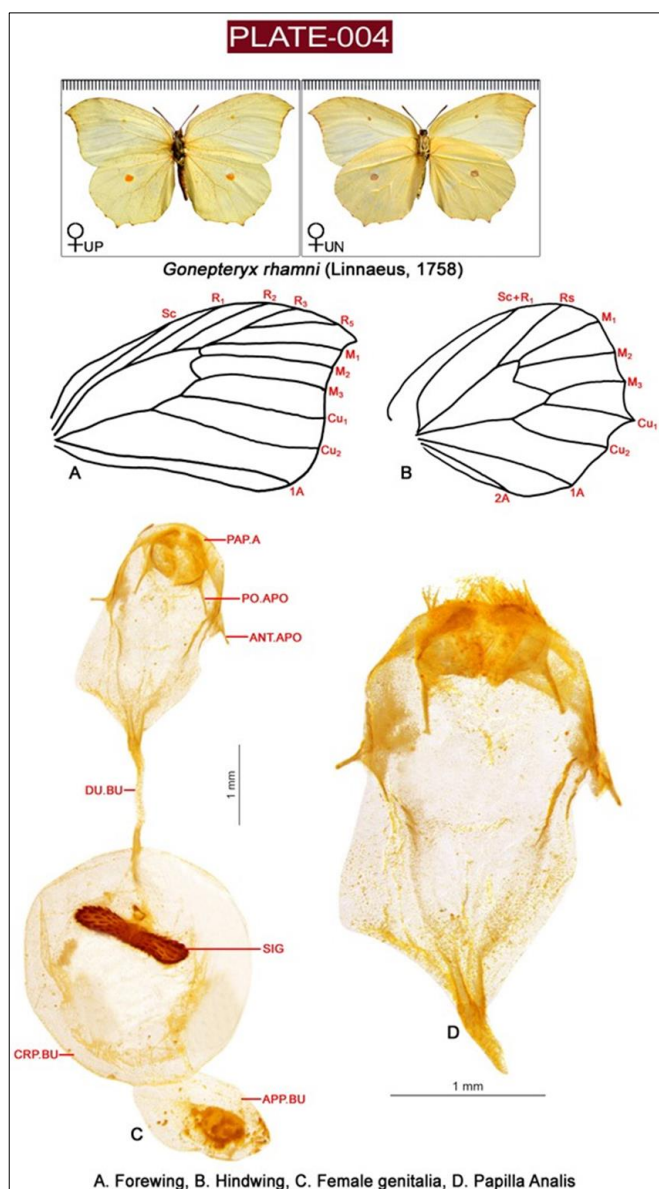
**Plate 3: Adult (Male)**

**Adult (Female) (PLATE-004)**

Forewing dorsal surface creamish-white; dark orange small spot at the end cell; brownish-red vein spots on the termen. Ventral surface yellowish-white; costa and apex more yellow, posterior part white; dark discocellular spot. Hindwing dorsal

surface creamish-white; dark orange rounded and large discocellular dot; marginal vein dots more prominent. Ventral surface yellowish-white; large spot at the end cell.

**Wing expanse:** 55-65mm.



**Plate 4:** Adult (Female)

**Male Genitalia:** Uncus small, very thin, tip blunt, slightly downcurved, linear in dorsal view; tegumen broad, triangular in dorsal view, narrow towards uncus; vinculum, narrow; saccus long, narrow, tube-shaped, blunt distal end; appendices angulares narrow; juxta sclerotized, V-shaped; valve leaf-like, apex protrudes to form a pointed tip, harpe spine-shaped; aedeagus long, narrow stick-shaped, suprazone longer than subzone, ductus ejaculatorious enters caudally.

**Female Genitalia:** Corpus bursae rounded, signum well sclerotized, covered with scattered spines, appendix bursae somewhat oval, ductus bursae very thin, papilla analis rounded, posterior apophysis and anterior apophysis very thin, linear, well sclerotized, anterior apophysis slightly smaller.

**Material Examined:** ZSI, Kolkata, National Museum

Collections.

2♂, 30.iv.1916, 1♂, 1♀, 1.v.1916, Nainital; 2♂, 1♀, 13.vii.1918, Mussoorie; 1♂, 1♀, 8.ix.1925, Shimla; 1♂, 5.vi.1953, Chakrata, Uttar Pradesh (Coll. Om Singh); 3♂, 1♀, 10.v.1956, Dehradun, (Coll. K.K. Tiwari); 1♂, 19.vi.1958, Shimla, (Coll. A.P Kapoor); 1♂, 28.vi.1968, Solan, (Coll. O.B Chhotani); 1♀, 23.vii.1974, Uttarkashi, (Coll. H.C Ghosh); 1♀, 10.x.1974, Shimla, (Coll. L.K Ghosh); 1♂, 8.vii.1991, Nagaland; 1♂, 28.ix.2001, Almora, Uttarakhand; 1♂, 21.ix.2005, Uttarkashi, Uttarakhand, (Coll. A.K Sidhu); 1♀, 26.ix.2005, Ranichouri, Uttarakhand, (Coll. A.K Sidhu).

**Distribution India:** Uttarakhand, Himachal Pradesh, Jammu and Kashmir.

**Elsewhere:** Russia, Syria, Siberia, Nepal, Europe, North Africa.

**Remarks:** *Gonepteryx rhamni* is a common species in the above mentioned localities. This species is widely distributed in the Palearctic zone including North Africa. Bingham (1907) [2] explained its morphological characters and distribution of this species. Antram (1924) [1] described its external morphological attributes, status, distribution and altitudinal range. Antram (loc. cit) found it common in North-West India and rare in Sikkim and Assam. Dixey (1894) [4] discussed the close relationship of *Dercas* with *Gonepteryx* on the basis of their phylogeny, wing markings and geographical distribution. Klot (1931) studied and illustrated their genitalic structures but did not compared those structures. In this present work, the morphological and genitalic attributes of *Gonepteryx rhamni* and *Dercas lycorias* have been studied, illustrated and compared. It has been observed that *Gonepteryx rhamni* resembles more with the *D. lycorias* form *decipiens* as in normal *D. lycorias* there is large rounded black spot in area  $M_3$  which is absent in *G. rhamni* and *D. lycorias* form *decipiens*. Both the species are neon- yellow with falcate apex of forewing. In *Dercas lycorias*, the apex of the forewing is falcate with narrow apical tip, the margin below the apex is incurved and dentate at vein ends of veins  $M_1$ ,  $M_2$  and  $M_3$  and the vein end of hindwing vein  $M_3$  dentate whereas in *G. rhamni*, the costal margin near the apex is strongly arched, apex falcate with slightly broad apical tip, hindwing with vein  $Cu_1$  prominently dentate and veins  $M_3$ ,  $Cu_2$  and  $1A$ . The aedeagus is very long in the representatives of both the genera but in case of *D. lycorias* it is extremely long. In *D. lycorias*, the saccus is extremely long and sinuous, valve with narrow and rounded distal tip whereas in *G. rhamni*, the saccus is long with thin proximal part and swollen distal end, valve leaf-like with distal end produced to form a blunt apical tip.

***Gonepteryx mahaguru* Gistel, 1857**

**Common name:** Lesser Brimstone

*Gonepteryx mahaguru* Gistel, 1857; *Achthundert und zwanzig...Unbeschreiben Insekten*: 93.

*Gonepteryx zaneka* Moore, 1865; *Proc. zool. Soc. Lond.* (2):493.

**Adult (Male) (PLATE-005)**

Forewing dorsal surface neon-yellow; costa more heavily curved to form a crescent apex; anterior veins possess brownish-red vein spots on the margins; small dark

disco-cellular dot; tornus rounded; dorsum straight. Ventral surface light greenish-white; brownish red vein spots on the margins of anterior veins; dark spot on end cell. Hindwing both the sides creamy-white with orange disco-cellular spot.

suprazone longer than subzone, ductus ejaculatorius enters caudally.

**Female Genitalia:** Corpus bursae small, spherical, signum sickle-shaped, well sclerotized, spinuous, appendix bursae small and rounded, ductus bursae very thin, papilla analis rounded, sclerotized; posterior apophysis and anterior apophysis narrow, little curved, sclerotized.

**Material examined:** ZSI, Kolkata, National Museum Collections.

1♀, 11.vi.1914, 1♀, 12.vi.1914, 1♂, 24.viii.1914, Mussoorei; 3♂, 1♀, 23.ii.1916, Nainital; 1♂, 27.2.1916, 2♂, 1.iii.1916, 1♀, 2.iii.1916, Kosi range, Nainital.

**Distribution India:** Uttarakhand, Kashmir.

**Elsewhere:** East China, Korea, Japan.

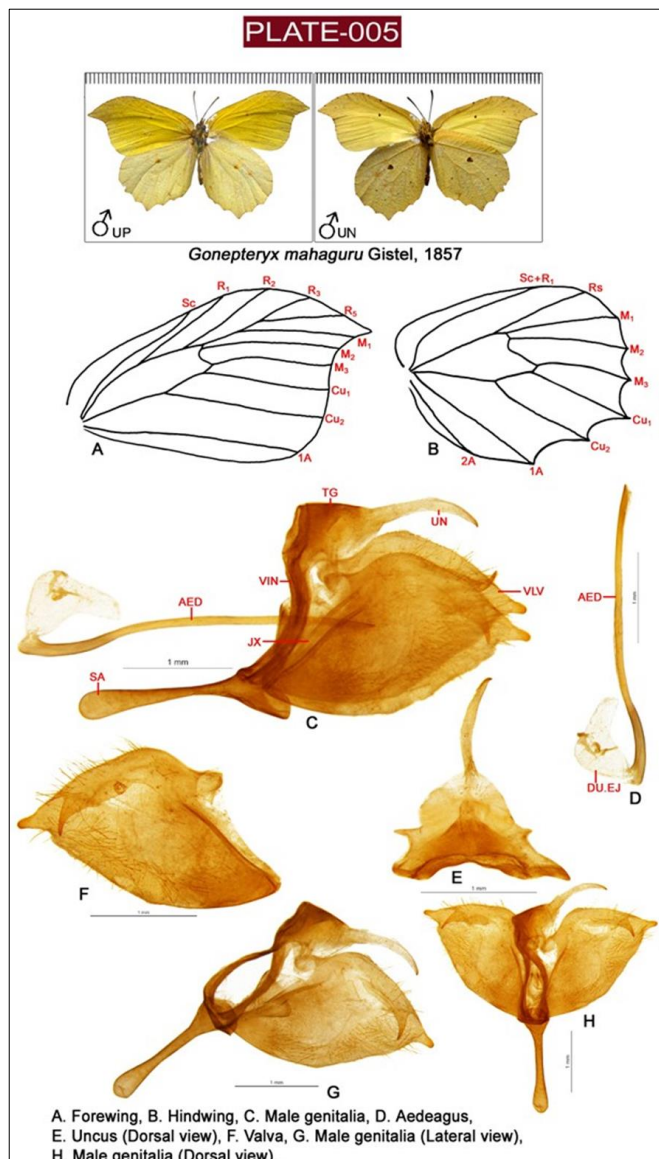


Plate 5: Adult (Male)

**Adult (Female) (PLATE-006):** Forewing dorsal surface creamy-white; anterior veins possess brownish-red vein spots on the margins. Ventral surface light brownish-white; anterior part light brownish-white; posterior part white; small spot at the end cell. Hindwing dorsal surface creamish-white; large orange spot at the end cell; outer margin forms toothed-like projections. Ventral surface brownish-white; large spot at the end cell.

**Wing expanse:** 55-65mm.

**Male Genitalia:** Uncus long, thin, arched, downcurved, tip pointed; tegumen broad, triangular in lateral view, narrow towards uncus, distal part sclerotized; vinculum, narrow, concave, sclerotized; saccus long, narrow proximally, broad blunt distal end; appendices angulares hook-like; juxta V-shaped; valve leaf-like, apex protrudes to form a blunt tip, harpe spine-shaped; aedeagus long, narrow stick-shaped,

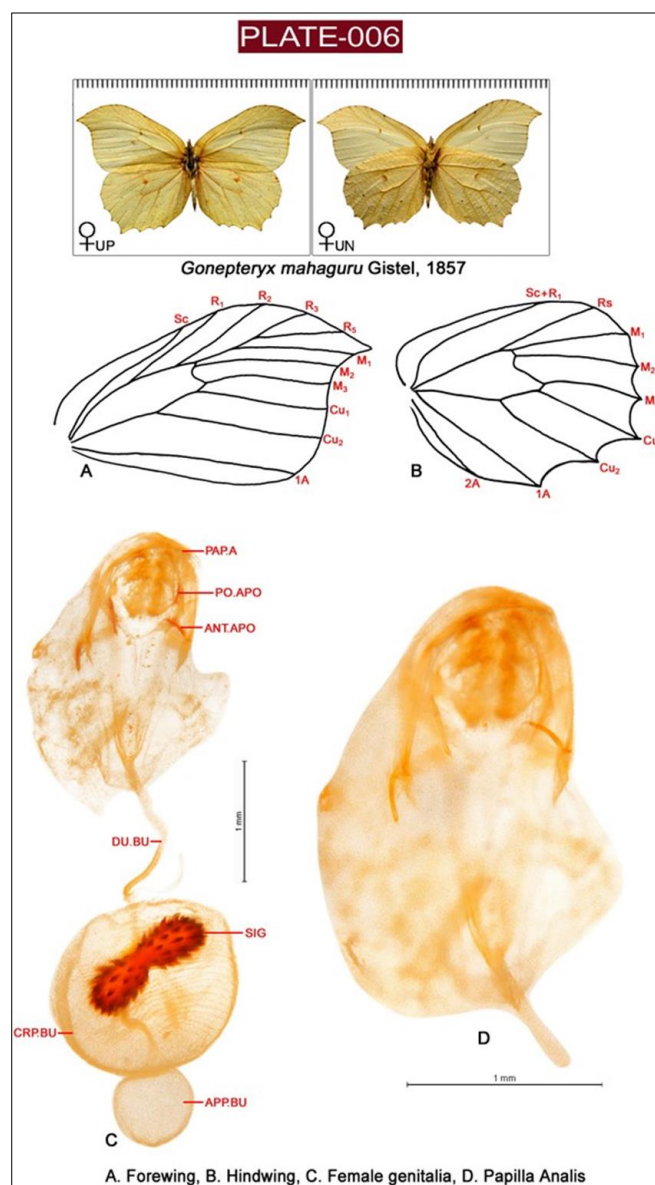


Plate 6: Adult (Female)

**Remarks:** *Gonepteryx mahaguru* is a common species distributed in Uttarakhand, Kashmir, East China, Japan and Korea. Evans (1932) [6] reported it as *G. aspasia* with its distribution. Talbot (1939) [9] described its morphological

characters in detail including its distribution. In this present work, the morphological and genitalic attributes of *G. rhamni* and *G. mahaguru* have been studied, illustrated and compared. The forewing is neon-yellow and hindwing is creamish-white in case of *G. mahaguru* whereas in *G. rhamni* both the wings are neon-yellow. In *G. mahaguru*, the forewing apex is more crescent than in *G. rhamni*. The uncus is long and arched with pointed distal tip, proximal part of saccus narrow and distal end swollen in *G. mahaguru* whereas in *G. rhamni* uncus is small with truncated distal tip, saccus equally broad throughout the length.

### Acknowledgements

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